Effect of STAD and Jigsaw IV Cooperative Learning Strategies on Students' Interest and Achievement in Basic Science in Nasarawa State, Nigeria

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Abstract
This study investigated the effect of Student Team Achievement Division and Jigsaw IV cooperative learning strategies on interest and achievement of Basic Science students. A simple random sampling procedure was employed to select 126 JSS II students from four public, coeducational schools in Karu Local Government Area of Nasarawa State. The quasi-experimental research design was employed for the study. Two research questions and two research hypotheses guided the study. Students' Interest in Basic Science (SIBS) and Basic Science Achievement Test (BSAT) were used as instruments for data collection. The reliability of SIBS was determined using Cronbach Alpha and the coefficient obtained was 0.82 while BSAT was determined using K-R20 formula and the reliability coefficient obtained was 0.85. Mean and Standard Deviation was used to answer the research questions while the hypotheses were tested at 0.05 level of significance using Analysis of Covariance (ANCOVA). Scheffe's post-test was used to determine the magnitude of the differences. The findings of the study revealed significant differences in the interest and achievement of students taught using STAD and Jigsaw IV cooperative learning strategies as against the use of the conventional lecture method for teaching basic science.

Keyword: *Basic Science, Achievement, Interest, Jigsaw IV, STAD cooperative learning strategies and Conventional approach.*

Introduction

The role of science and technology in the development of a nation is not in dispute. It is evident that the current development in science and technology has greatly affected the lives of human beings so much that to be ignorant of the basic knowledge of this development is to live an empty, meaningless and probably unrealistic life. It will also be difficult for a nation with a scientifically and technologically illiterate citizenry to make any reasonable political decision on issues of everyday life such as the environment, agriculture, health, transport, and communication or population growth. This is so because such a nation lacks the rudimentary tools to grasp the various arguments that are necessary for taking such decisions. Science and Technology, therefore, have a privileged function of exerting a domineering influence on the development of a nation (Kabutu, Oloyede & Bandele, 2015).

The vital role played by science in contemporary society is indispensable in recognition of the important role of science for national development, the Federal Republic of Nigeria in the National Policy on Education (FRN, 2014) gave a special place to science, technology and mathematics education and the promotion of scientific and technological literacy to her citizenry. In addition, the government put in place some reforms and measures aimed at harnessing the human and material resources in the country. Prominent among these is the National Policy on Science and Technology that has spelt out objectives and direction of science and technology education in Nigeria. Some of the objectives are;

a. Producing world-class scientists, engineers, and technologists who are well grounded in theory, the practice of basic science and the needs of entrepreneurship.
b. Providing adequate support for continuous training of academic staff in tertiary and research institutions.
c. Strengthening the curricula in technological entrepreneurship and management of technology for science and engineering students.
d. Mainstreaming students in arts and social sciences to appreciate the relevance of science and technology and invention (STI) to profitability in business as well as natural development.
e. Encouraging and providing opportunities for the products of informal training schemes in STI for further formal training.

f. Strengthen capacity building institutions within the military, public and private sectors of the economy.
g. Facilitate standardized on-the-job training for professionals in STI organizations.
h. Promoting academic industry exchange programs to enhance knowledge sharing (FRN, 2011,p.4).

Despite all the aforementioned which are aimed at improving the production of scientists and the subsequent development and use of scientific products among the citizenry, students' achievement has remained largely not encouraging (Oni, 2014). The persistent underachievement in science and technology if not checked, will continue to jeopardize the placement chances of students in post-secondary institutions. This has serious implications for national development, security, economy, and manpower for a country with a vision of becoming one of the leading nations in science and technology (Gambari & Yusuf, 2017).

Researchers (Alabi, 2014; Idowu, 2011; Bukunola & Idowu, 2012; Osokoya, 2013; Oni, 2014; Kabutu, Oloyede & Bandele, 2015; and Samuel, 2017) observed that poor instructional strategies employed in the teaching of the subjects by teachers contribute to students underachievement. Students find it difficult to understand the basic concepts taught. Hence a child that is not well grounded in science and technology at the basic level will not show interest in offering core science and technology subjects. In order to achieve the objectives of Basic Science education, the student-activity-based mode of teaching strategies has been recommended by the Federal Republic of Nigeria (FRN, 2014). An example of one of these strategies is the cooperative learning strategy.

Cooperative learning can be defined as a teaching strategy that involves students into learning process in order to understand and learn the content of the subject (Slavin, 1986). Traditional class activities create a win-win situation, where one can only succeed if others lose, while cooperative learning is a direct opposite of it in the latter case, the conquest of all is the success of all. Cooperative learning has the edge over other teaching methods in terms of its effectiveness for improved cognition, social skills and motivation (Ajaja & Eravwoke, 2010; Anowar & Rohanni, 2012; Gull & Shehzad, 2015; Bukunola & Idowu, 2012; Kabuttu, Oloyede & Bandele, 2013 and Gambari & Yusuf, 2017).

There are dozens of strategies that can be used by the teachers under the umbrella of the cooperative learning process, some of them have gained more popularity than others, this includes; Students Team Achievement Division (STAD) and Jigsaw IV.

In STAD strategy, students are assigned to a heterogeneous group that consists of three members that are mixed in achievement level and genders. Students take a group quiz during which they reach consensus in decision-making. They also take individual quizzes on the material without helping one another. Students' scores are then summed up to form team scores. Teams that meet certain criteria earn certificates or other rewards (Slavin, 1986).

In Jigsaw, students are assigned to three-member teams to work on academic materials. Initially, all students are assigned to study and understand the basic concept of the materials. Later, each student is given a section/topic on which to become an expert. Students with the same section/topic meet in expert groups to discuss their topic, after which they return to their original teams to teach what they have learned to their teammates. The students take a group and individual quizzes that result in a team score based on the improvement score system (Slavin, 1986). The Jigsaw IV includes three new features: an introduction, quizzes, and re-teaching of material after an individual assessment which makes it better than Jigsaw I, II and III (Janson, Somsook & Coll, 2008)

Achievement is the action of accomplishing an academic task successfully. Its purpose is to find out the stand of a student at a given moment (Akani, 2017). It has to do with testing the knowledge acquired by the student which help the teacher and the student to evaluate and predict the degree of learning attained. It is useful in testing the retention of information and skill. It is also a determinant of the efficacy and efficiency of a given instruction (Kabutu, Oloyede & Bandele, 2015).

Interest is considered to be the feeling of an individual towards a particular object or an activity. It means that a child will develop an interest in an object or activity that is found to be attractive or stimulating. Therefore, in a classroom situation, the learner will be attentive during a lesson only if the instruction is appealing to the learner (Danjuma, 2015).

Gender remains an important factor to be considered in the determination of effects of cooperative instructional strategies on the academic achievement of students. Gender has been identified as a major factor that affects students' achievement in Basic Science and Technology examinations and science and technology as endeavor (Omiko, 2017). Oni 2014 posited that in Nigeria, women are marginalized while men are given greater opportunities to advance based on their science background. In the Nigerian setting, this factor has been found to offer males an unfair advantage over their female counterparts. Alabi (2014) reported that women are hindered from progressing through discrimination on the basis of gender, early marriage, and childbearing and as a result, they have deprived sound education, job opportunities and incapacitated and rendered passive generally in the society.

The persistent underachievement of students in Basic Science and Technology is alarming. The present study, therefore, is aimed at determining the extent to which classroom exposures of students to STAD, Jigsaw II, and TAI will enhance Basic Science and Technology students' achievement. Specifically, the study sought to find out;

1. The effect of STAD and Jigsaw IV cooperative learning strategies on students' interest in Basic Science.
2. The effect of STAD and Jigsaw IV cooperative learning strategies on students' achievement in Basic Science.
3. The effect of STAD and Jigsaw IV cooperative learning strategies on students' interest in Basic Science based on gender.
4. The effect of STAD and Jigsaw IV cooperative learning strategies on students' achievement in Basic Science based on gender.

Research Questions

1. What is the effect of STAD and Jigsaw IV cooperative learning strategies on students' interest in Basic Science?
2. What is the effect of STAD and Jigsaw IV cooperative learning strategies on students' achievement in Basic Science?
3. What is the effect of STAD and Jigsaw IV cooperative learning strategies on students' interest in Basic Science based on gender?
4. What is the effect of STAD and Jigsaw IV cooperative learning strategies on students' achievement in Basic Science based on gender?

Research Hypotheses

Ho_1: There is no significant difference in the mean interest scores of students taught Basic Science using STAD and Jigsaw IV cooperative learning strategies and those taught using the Conventional Lecture Method.

Ho_2: There is no significant difference in the mean achievement scores of students taught Basic Science using STAD and Jigsaw IV cooperative learning strategies and those taught using the Conventional Lecture Method.

Ho_3: There is no significant difference in the mean interest scores of students taught Basic Science using STAD and Jigsaw IV cooperative learning strategies based on gender.

Ho_4: There is no significant difference in the mean achievement scores of students taught Basic Science using STAD and Jigsaw IV cooperative learning strategies based on gender.

Methodology

Quasi-experimental, non-equivalent pretest, and post-test, control group design was employed for the study. The sample for the study comprised one hundred and twenty-six JSS II Basic Science students from four intact classes randomly selected from public coeducation schools in Karu Local Government Area of Nasarawa State, Nigeria. The experimental groups I and II were taught using STAD and Jigsaw IV cooperative learning strategies respectively while the control group was taught using the conventional lecture approach.

Two instruments were used for data collection namely; Students' Interest in Basic Science (SIBS) and Basic Science Achievement Test (BSAT). SIBS contained 20 items designed to determine students' interest in Basic Science. SIBS was rated using a four-point rating scale. The options were; strongly agree (SA) = 4 points,

Agree (A) = 3 points, Disagree (D) = 2 points and Strongly Disagreed (SD) = 1 point. BSAT was a 20 item instrument with options A – D that tested the students' knowledge, comprehension, application of selected topics in Basic Science and Technology. The items were allotted 2marks each, culminating in the total score of 40marks. The test was validated by experts and was trial-tested. Students' Interest in Basic Science (SIBS) and Basic Science Achievement Test (BSAT) was used as an instrument for data collection. The reliability of SIBS was determined using Cronbach Alpha and the coefficient obtained was 0.82 while BSAT was determined using K-R20 formula and the reliability coefficient obtained was 0.85 implying that the instruments were reliable. Mean and Standard Deviation was used to answer the research questions while Analysis of Covariance (ANCOVA) was used to test the research hypotheses at 0.05 alpha level of significance. Scheffe's post hoc test was used to determine the magnitude of the differences among the strategies of instruction used.

Results

Research Question One:

What is the effect of STAD and Jigsaw IV cooperative learning strategies on students' interest in Basic Science?

The mean and standard deviation of students taught Basic Science using STAD and Jigsaw IV cooperative learning strategies and conventional lecture method is presented in Table 1.

Table 1:

Mean, and Standard Deviation of Interest Scores of Students Taught Basic Science Using STAD and Jigsaw IV Cooperative Learning Strategies and Conventional Lecture Method.

Teaching method	Type of test	No of students	X	SD	INTEREST GAIN
STAD	Pre-test	46	30.15	9.84	
	Post-test	46	55.23	12.87	25.08
Jigsaw IV	Pre-test	42	35.56	9.57	
	Post-test	42	58.18	12.63	22.62
Conventional Lecture Method	Pre-test	38	40.03	7.73	
	Post-test	38	45.39	8.21	05.36

Table 1 shows that the mean interest gain of students taught Basic Science using STAD and Jigsaw IV cooperative learning strategies were 25.08 and 22.62 respectively. While those taught using the conventional lecture method had a mean gain of 05.36. This result indicates the positive effect of the learning strategies on students' interest in Basic Science.

Research Question Two

What is the effect of STAD and Jigsaw IV cooperative learning strategies on students' achievement in Basic Science?

The mean and standard deviation of the scores of BSAT are presented in Table 2.

Table 2:

Mean and Standard Deviation of Mean Achievement Scores of Students Taught Basic Science and Technology Using STAD and Jigsaw IV Cooperative Learning Strategies and Conventional Lecture Method.

Teaching method	Type of test	No of students	X	SD
STAD	Pre-test	46	20.55	8.99
	Post-test	46	65.43	10.87
Jigsaw IV	Pre-test	42	25.56	9.57
	Post-test	42	68.38	12.63
Conventional Lecture Approach	Pre-test	38	50.03	7.73
	Post-test	38	55.39	9.21

Table 1 shows that the mean scores of students taught Basic Science using STAD and Jigsaw IV cooperative learning strategies were 65.43 and 68.38 respectively. While those taught using the conventional lecture method

had a mean score of 55.39. This result shows that learning strategies have some effects on students' achievement in Basic Science.

Research Question Three

What is the effect of STAD and Jigsaw IV cooperative learning strategies and gender on students' interest in Basic Science?

The mean and standard deviation of students' interest in Basic Science using STAD and Jigsaw IV cooperative learning strategies and conventional lecture method are presented in Table 3.

Table 3:

Mean, and Standard Deviation of Interest Scores of Students Taught Basic Science Using STAD and Jigsaw IV Cooperative Learning Strategies and Conventional Lecture Method Based on Gender.

Teaching method	Type of test	No of students, mean scores, SD and mean gain							
		F		SD	MG	M		SD	MG
STAD	Pre-test	20	15.25	3.98		26	17.65	4.31	
					3.37				6.89
	Post-test	20	18.62	5.71		26	24.54	7.02	
Jigsaw IV	Pre-test	18	19.06	7.14		24	15.76	4.35	
					2.96				11.39
	Post-test	18	22.02	9.12		24	27.15	8.61	
Lecture Method	Pre-test	18	12.07	2.82		20	15.13	3.15	
					3.33				4.32
	Post-test	18	15.40	3.09		20	19.45	5.34	

M=Male, F=Female, X=Mean, SD= Standard Deviation. MG=Mean Gain

Table 3 shows that the mean interest gain of male students taught using STAD and Jigsaw IV cooperative learning strategies are higher than those of the female students.

Research Question Four

What is the effect of STAD and Jigsaw IV cooperative learning strategies on students' achievement in Basic Science based on gender?

The mean and standard deviation of students' achievement in Basic Science using STAD and Jigsaw IV cooperative learning strategies and conventional lecture method are presented in Table 4.

Table 4:

Mean Scores and Standard Deviations in the Achievement of Male and Female Basic Science Students Taught using STAD and Jigsaw IV Cooperative Instructional Strategies and Lecture Method

Teaching method	Type of test	No of students, mean scores, SD and mean gain							
		F		SD	MG	M		SD	MG
STAD	Pre-test	20	16.25	3.98		26	18.76	4.31	
					3.37				7.73
	Post-test	20	19.62	6.91		26	26.49	7.02	
Jigsaw IV	Pre-test	18	20.16	9.34		24	17.85	4.35	
					5.06				13.01
	Post-test	18	25.22	10.15		24	30.86	8.61	
Lecture Method	Pre-test	18	14.27	2.92		20	17.56	3.15	
					2.61				3.02
	Post-test	18	16.88	3.59		20	20.58	5.34	

M=Male, F=Female, X=Mean, SD= Standard Deviation. MG=Mean Gain

Table 4 shows that the mean achievement gain of male students taught using STAD and Jigsaw IV cooperative learning strategies are higher than that of the female students Basic Science with Jigsaw IV having the highest mean achievement gain.

Hypothesis One:

Ho_1: There is no significant difference in the mean interest scores of students taught Basic Science using STAD and Jigsaw IV cooperative learning strategies and those taught using conventional lecture method.

Table 5:

The result of Analysis of Covariance on Students' Interest in Basic Science

Source	Type III Sum of squares	df	Mean square	F	Sig.	Result
Corrected model	113857.931	2	5644.9635	98.962	0.000	S
Intercept	574.372	1	694.372	14.766	0.001	S
Pretest Interest	2896.539	1	2896.539	51.356	0.000	S
Gender	187.193	1	187.193	.871	0.253	S
Group	8954.306	1	8954.306	57.032	0.000	S
Error	5325.510	120	32.8735			
Total	29160.658	126				

Significant at P<0.05

Table 3 shows a significant difference among the learning strategies on interest, F= ratio of 57.032, P<0.05. The null hypothesis of no significant difference was rejected indicating that there was a significant difference.

Hypothesis Two

Ho_2: There is no significant difference in the mean achievement scores of students taught Basic Science using STAD and Jigsaw IV cooperative learning strategies and those taught using the Conventional Lecture Approach.

To determine whether there were significant differences in the Post-post-test mean scores of STAD, Jigsaw II, TAI groups and the conventional lecture method control group, data were analyzed using analysis of covariance (ANCOVA) in Table 6.

Table 6:

The result of Analysis of Covariance on Students' Academic Achievement Scores in BSAT

Source	Sum of squares	Df	Mean square	F	Sig.	Result
Corrected model	2890.931	2	564.9635	89.962	0.000	S
Intercept	4794.372	1	694.372	14.766	0.001	S
Pretest	296.539	1	2896.539	51.356	0.000	S
Gender	9.574	1	9.574	.076	0.863	S
Group	8954.306	1	8954.306	77.032	0.000	S
Error	4325.510	120	222.735			
Total	32160.658	126				

Significant at P<0.05

Table 4 shows a significant difference among the learning strategies on achievement, F= ratio 157.032, P<0.05. The null hypothesis of no significant difference was rejected indicating that there is a significant difference. Based on the established significant difference in the post-test achievement scores of the groups, Scheffer's test was used for post-hoc analysis to determine the magnitude of the difference. The results of the post-hoc analysis are as shown in Table 7

Table 7:
Scheffe's post-hoc Results of Students' Achievement Mean Scores of STAD and Jigsaw IV Conventional Lecture Approach.

Groups	Mean scores	STAD	Jigsaw IV	Conventional lecture approach
STAD	69.34		0.652	0.243
Jigsaw IV	72.02	0.652		0.004
Conventional lecture approach	54.32	0.243	0.004	

The mean difference is significant at 0.05 level.

The results shown in Table 7 indicate that there was no significant difference in the Post-post-test mean scores of students exposed to STAD (X=69.34) and those exposed to Jigsaw IV (X=72.02). There was a significant difference in the Post-post-test mean scores of students exposed to Jigsaw IV (X=72.02) and those exposed to conventional lecture method (X=54.32) in favour of Jigsaw IV.

Hypothesis Three

Ho_3: There is no significant difference in the mean interest scores of students taught Basic Science using STAD and Jigsaw IV cooperative learning strategies based on gender.

The result in Table 5 shows that with respect to the interest mean scores of male and female students taught Basic Science using STAD and Jigsaw IV cooperative learning strategies, an F- the ratio of 0.87 was obtained with an associated probability value of 0.38. Since the associated probability value (0.38) was greater than 0.05 set as a benchmark, the hypothesis was not rejected. This implies that male and female students taught Basic Science using STAD and Jigsaw IV cooperative learning strategies did not differ significantly in their interest towards Basic Science. Thus, gender is not a significant factor affecting students' interest in Basic Science when taught Basic Science using STAD and Jigsaw IV cooperative learning strategies.

Hypothesis Four

Ho_4: There is no significant difference in the mean achievement scores of students taught Basic Science using STAD and Jigsaw IV cooperative learning strategies based on gender.

The result in Table 6 shows that with respect to the interest mean scores of male and female taught Basic Science using STAD and Jigsaw IV cooperative learning strategies, an F- the ratio of 0.076 was obtained with an associated probability value of 0.86. Since the associated probability value (0.86) was greater than 0.05 set as a benchmark, the hypothesis was not rejected. This implies that male and female students taught Basic Science using STAD and Jigsaw IV cooperative learning strategies did not differ significantly in their achievement in Basic Science. Thus, gender is not a significant factor affecting students' achievement in Basic Science when taught Basic Science using STAD and Jigsaw IV cooperative learning strategies.

Discussion

The result from the study revealed a significant difference between the achievement of Basic Science and Technology students in STAD and Jigsaw IV cooperative learning strategies and conventional lecture method in favour of the cooperative learning strategies. This result indicates that the cooperative learning strategies are more effective in enhancing Basic Science students' interest and achievement than the conventional lecture method.

The findings of the study are consistent with the findings of (Keramati, 2010; Yusuf & Afolabi, 2010; Ajaja & Eravwoke, 2010; Anowar & Rohanni, 2012; Bukunola & Idowu, 2012; Gull & Shehzad, 2015; Odagboyi, Otuka & Uzoechi, 2015; Kabutu, Oloyede & Bandele, 2015; Gambari & Yusuf, 2017), who in their various researchers reported that, students taught using cooperative learning strategies achieve better academically than those taught using the conventional lecture method. In relation to interest, the researchers found that cooperative learning strategies had greater ability to increase the interest of Basic Science students compared to the conventional lecture method. This is in line with the findings of Danjuma (2015) who found that cooperative learning strategies have a positive effect on students' interest in Basic Science.

These findings have strong implications for the teaching and learning of Basic Science and Technology in secondary schools in Nigeria using cooperative learning strategies.

Conclusion

The findings of the study have shown that; STAD and Jigsaw IV cooperative learning strategies are a way of improving interest and achievement in Basic Science at the Junior Secondary School level in Nigeria. The present conventional lecture method employed by teachers should drastically be minimized and only used in concert with more student-centered approaches.

Recommendations

1. Cooperative learning strategies should be used to enhance the teaching and learning of Basic Science and Technology. This is because it is innovative and has the potential to motivate learners towards learning science.
2. Students should always be encouraged to work together in groups so as to enable them to imbibe the culture of working together cooperatively in order to promote their understanding of science.
3. Proprietors of school should organize seminars and workshops to equip teachers to enable them to acquire more knowledge and skills of how to use cooperative learning strategies in the teaching and learning of Basic Science.

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